

SOME POSSIBILITIES IN BREEDING PLANTS USED FOR COVER, GREEN MANURE, AND SHADE¹

The greatest development in the use of plants for cover, green manure, and shade is found in countries where permanent crops are grown on the scale of an estate as in Java, Sumatra, Federated Malay States and probably also in India, Ceylon, and other countries. In these regions perennial crops such as rubber, cinchona, coconut, oil palm, tea, coffee and the like are more important sources of profit than some annuals like rice, maize and similar food plants.

In Java, estate managers wage a constant war against weeds. This fight is so intense that to eradicate and control the weeds either the clean culture system is employed or cover crops are grown not only between rows of plants but in every conceivable nook and available spot on the plantation, even right in the paths and roads of the farm. Some of the cover plant species used are also turned under as green manure or used to shade nursery plants and those newly transplanted in the field.

The largest collection I have seen of plants used and being tested as green manure, and for covering spaces between cultivated plants to control weeds, and for shading nursery plants and young plants in the field—aid plants, as they may be called for brevity—is that belonging to the Tea Experiment Station at Buitenzorg, Java. The collection consists of plants already in general use as well as wild plants collected in Java and of plants of different species from many tropical countries. Any one interested in the list of the aid plants used in Java should consult the works of Backer and Van Slooten (1924)² for cover and shade plants and green manures and of Wigman (1926)³ for road trees. Some of the most important species in the collection are: *Acacia decurrens* Willd., *Cajanus cajan* Millsp., *Calopogonium muconoides* Desv., *Cassia mimosoides* L., *Crotalaria anagyroides* H. B. K., *Crotalaria usaramoensis* Baker, *Desmodium gyroides* D. C., *Indigofera hendecaphylla* Jacq., *Indigofera sumatrana* Gaertn., *Leucaena glauca* (L.) Benth., *Mimosa invisa* Mart., *Sesbania grandiflora* Pers., *Tephrosia noctiflora* Bojer, *Tephrosia Vogelii* Hook., and *Vigna Hosei* Backer.

The strange thing about the use of these aid plants is that, with few exceptions, no thought has been given to selection, even among the varieties

¹ General contribution from the College of Agriculture No. 205.

² Backer, C. A. en D. F. van Slooten. 1924. Javaansche theeonkruiden en hunne beteekenis voor de cultuur. Algemeen Proefstation voor Thee. Java.

³ Wigman, H. J. 1926. Wegboomen No. 2. Publicatie van de Nederlandsch Indische Wegenvereeniging, Bandoeng, Java.

making up each species, not to speak of individual strains and plants within a variety. The unit taken so far has been usually the species, and when one of these does not satisfy, the tendency, naturally, has been to follow the route of least resistance; namely, the trial and use of other species. This is passing strange when it is realized that the use of cover crops, green manures, and shade plants is as essential as the planting of the regular economic plants with which they are generally grown and that many species in use, despite their undesirable characters, have never been replaced by others.

Road plants are more or less permanent in nature and the choice not only of proper species for a given locality but also of varieties and healthy and vigorous plant materials can not be over-emphasized. Practically no attention is given to this phase of the work. Seedlings of different varieties and ages are planted promiscuously. It is time that some serious thought be given to this point by those in charge of the roads.

There are still so many species of plants untried for their value as shade plants, and as cover plants and green manures that for a long time experiment stations and estate managers and planters have been content to try uninvestigated species to replace undesirable ones in use instead of performing selection or improvement with them. The time seems to be approaching, however, when plant breeding will be called upon to improve some of the most valuable species now under cultivation. The cause of the failure of some of these plants to keep up their reputation has been the lack of selection. For example, formerly, *Erythrina* species were in high esteem as shade trees. According to Alberts⁴, lack of proper selection has been one of the main causes of its being less important at present in this respect than *Leucaena glauca*.

That the species widely used have their respective defects is known to all those who have had long experience in using them. Some examples may be cited. *Mimosa invisa* Mart. is considered one of the best, if not the best, species for use in eradicating and controlling weeds, and is generally used in eradicating the *cogon*, or *atang-alang* (*Imperata cylindrica* (L.) Beauv.). *M. invisa* produces an abundance of seeds, is self-sowing, or self-perpetuating, grows satisfactorily, and is not troubled by insects or disease. It gives a good amount of humus and is a good green manure. Its only defect seems to be that its stem is thorny. When it is so planted that a roller can be used to bring it down before it is plowed under, the thorniness is not a very great disadvantage. Under some circumstances a roller can not be used and it has to be handled by laborers who greatly dislike the thorns for they cause scratches and pricks which at times require prolonged medical treatment. It has been said that a thornless variety of this species would be worth a million pesos. Mr. L. Koch of the General Experiment Station

⁴Alberts, G. A. 1915. Lamtoro als schaduw. Mededeelingen van het Proefstation Malang. No. 10.

at Buitenzorg made an attempt to select plants on the basis of the length of the thorn with a view to ultimately eliminating it, but no positive results were obtained. Here, then, is a wide field for service for plant breeders. Mr. A. A. M. N. Keuchenius, who is in charge of the green manure and cover crop garden of the Tea Experiment Station in Java told the writer he was trying to attack this thorn problem with the *M. invisa* by crossing it with *Neptunia plena*, which is thornless and looks somewhat like the *Mimosa*, although not so thickly growing. Let us hope a thornless hybrid will be produced that is *M. invisa* in many respects but is without the thorn.

Meanwhile our local Bureau of Agriculture is forced to study the question as to whether the propagation of *Mimosa invisa* in the Philippines should be allowed or should be prohibited because it might become an undesirable weed. Were it spineless there would be no hesitation in encouraging the spread of this very important legume.

Leucaena glauca is used generally in Java, especially on tea estates, as a shade plant. It is periodically pruned. It is also planted thickly as a low hedge along the edges of terraces to prevent erosion on slopes. The roots of *Leucaena* penetrate the ground so deeply, even the hard subsoils, that in certain places it has been used to drill holes through hard subsoil for purposes of drainage. This species is not troubled by leaf diseases. The main defect of *Leucaena glauca* as a shade plant is that it grows so fast and recovers so fast after pruning that the cost of upkeep is rather high. For this reason the Tea Experiment Station at Buitenzorg is trying to find some other species better than *L. glauca*. Another defect of *L. glauca* is that it is a heavy seed producer, and drops seeds constantly, and the seedlings from these seeds, especially in places of fairly uniform rainfall throughout the year, make frequent weeding necessary. Doctor Cramer of Java once started selection of parent trees with sparse seeding habit to eliminate this special defect and this work evidently was attended with success. It is said that sterile and almost sterile strains were found.

Experiment stations in other countries may follow the examples set by Dutch plant breeders in Java. They can enlarge the scope of their work by thoroughly studying the plant breeding possibilities with the plants they use for cover, green manure, and shade, and start isolation and hybridization work with these important aid plants.

NEMESIO B. MENDIOLA
Of the Department of Agronomy

THE HISTORY OF THE UNITED STATES

The history of the United States is a story of growth and development. It begins with the first settlers who came to the continent in search of a new life. They found a land of vast resources and opportunities, but also one of many challenges. The early years were marked by conflict and struggle, as the settlers fought to establish their communities and defend their rights. Over time, the United States grew from a small collection of colonies into a powerful nation. It expanded its territory, developed its economy, and established a system of government that has inspired the world. The history of the United States is a testament to the power of the human spirit and the ability of a people to overcome adversity and build a better future.

CHEMICAL STUDIES ON COCONUT PRODUCTS: II. UTILIZATION OF THE COCONUT¹

N. GALVEZ, R. MORENO, AND V. G. LAVA
Of the Department of Agricultural Chemistry

Coconut, which in 1906 for a second time became nationally important to the Philippines, is now the country's second greatest export. According to the Bureau of Commerce and Industry, the yearly production of copra in the Philippines for the last ten years has been around 350 million kilograms; the value of the exported oil, copra, cake, and desiccated coconut for 1925 was ₱76,580,957 or about 27 per cent of our total exports. Figures from the Statistical Bulletin of the Philippine Islands show that the Philippines furnishes about one-third of the world's supply of copra. Efforts are being made in some countries to bar coconut oil from the market that some other oils may be favored; the final outcome will depend upon the cheapness of production of coconut oil. And the cost of production will depend not only upon proper fertilizing of the plantations, sound farm management, and marketing, but also upon the extent to which the waste products of coconut may be utilized.

The object of this paper is to review briefly the uses which the Filipinos and the industries have found for the different parts of the coconut plant, and to point out a few studies that could be made regarding some of its products.

Of the different parts of the coconut palm; namely, the roots, trunk wood, leaves, and nuts and flower spathe, hardly anything will be wasted under proper management.

THE ROOT, TRUNK, AND LEAVES

The roots contain tannin, and according to Sampson (1923) have been used as an astringent. The wood, if old and seasoned by soaking in salt water for about a month, may be used as posts, flooring, and rafters for houses; if well polished, it will serve as material for cabinet work and canes. The waste wood may be used for fuel, to make feeding troughs for pigs, and floats for fishing nets.

The leaves if taken green can be used as material for screens and partitions, windows, mats, and baskets, as well as for raincoats and hats. The young leaves, called *palaspas*², are used for wrapping rice cakes called

¹Experiment Station contribution No. 541. Received for publication, June 26, 1928.

²On Palm Sunday the *palaspas* is carried to church to be blessed. The Filipinos use them as a charm against earthquake and lightning.

suman. The midribs may be used to make brooms and baskets. The young petiole may be used for tying purposes. From the fibrous stipule, brushes and hats and native raincoats may be made; it can be used also as substitute for horsehair for stiffening clothing and furniture (Sampson, 1923). The fibers in the inner spathe are used in place of rope for tying fences; this rope stands the weather as well as any other.

In case the coconut plant is found unproductive or is attacked by some disease, it may be cut down and the young stem tissues, the cabbage, may be used for food as a salad. The leaves, when burned, yield an ash rich in soda potash and phosphoric acid which may be used for making soap, or as a constituent of fertilizers.³

THE NUT

Of all the parts of the coconut, the nuts give the most income. From these come the meat, the water, the shell, and the husk.

The meat may be taken fresh from the nuts and when cleaned and shredded and thoroughly dried under partial vacuum, the product is sold as desiccated coconut; this is widely used as an ingredient in puddings, cakes, pastries, and candies.

Locally, the fresh meat is grated and pressed with hot water to give a thick emulsion called *gatâ*. This is used much the same as cow's milk in making various desserts; it is also heated and the oil separated, leaving a nitrogenous residue, *latek*. Both the oil and *latek* are used for food.

The meat and water of the young coconut, known as the *buko*, are widely used on warm days, in much the same way as ice cream or cooling drinks. In localities where the source of water is not well known or considered sanitary, travelers rely wholly upon the water of the young coconut. Furthermore, it has been observed that young coconut water is a good diuretic.

When grated meat is dried with sugar the product is commonly known as *bukayô*, a sweet, very much in demand among Filipinos.

The bulk, however, of fresh meat is first treated to produce the copra, which is later pressed for oil. This is the method used to prepare oil on a commercial scale. The oil may be used directly in the manufacture of soap and candles. The crude oil is sometimes used by Filipinos for illuminating purposes. Soaps prepared exclusively from pure coconut oil were shown by Walker (1926) to be very effective disinfectants against typhoid bacilli, paratyphoid bacilli, and dysentery bacilli.

The stability of pure coconut oil makes it a good ingredient in the manufacture of many toilet preparations, such as creams and pomades

³ Analysis of the ash of the pinnae in the laboratory of the Department of Agricultural Chemistry in this College shows the following results: $K_2O=9.67\%$; $Na_2O=2.77\%$; $P_2O_5=1.93\%$; the ash of the petiole was found to contain 10.67% Na_2O ; 18.71% K_2O ; and 7.27% P_2O_5 .

Experiments on the rate of hydrolysis of coconut oil, carried out in the Chemistry Laboratory in this College show that when placed in a glass container, pure coconut oil hydrolyses to only a very slight extent.

TABLE 1
Showing rate of hydrolysis of pure coconut oil

AMOUNT OF WATER MIXED WITH THE OIL	OLEIC ACID AT THE BEGINNING		OLEIC ACID AT THE END OF 4 MONTHS		RANCIDITY
	Covered	Uncovered	Covered	Uncovered	
<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	<i>per cent</i>	
37.61	.15	.15	.44	.44	Negative
38.71	.15	.15	.60	.45	"
23.11	.15	.15	.60	.45	"
16.81	.15	.15	.45	.60	"
10.00	.23	.23	.46	.53	"
3.96	.23	.23	.46	.46	"
.11	.23	.23	.31	.31	"

From table 1 it is evident that pure, or refined coconut oil may be used in the manufacture of vegetable lard⁴, oleomargarine and ointment; in fact, stable emulsions, such as mayonnaise, etc., have been prepared by Ayre (1923) from refined coconut oil.

Coconut oil has been shown by Cohn (1924) to be an adulterant of cacao butter, and Southcombe and Wells (1920) have shown that it can be used as an adulterant in lubricants. It has been recommended by Spiers and Bitte (1926) as a constituent in the preparation of a mixture for oiling scoured wool. Keghel (1913) found it very useful as a constituent of a solution for the industrial preservation of eggs. Artificial petroleum which has been prepared from soybean oil and fish oil has been prepared by Kobayashi (1921) from coconut oil by heating the oil with Japanese acid clay. It has, furthermore, been found by Rivera (1925) that coconut oil has a slight curative effect on leprosy.

When the oil is subjected to distillation with one to two per cent sulfuric acid, the fatty acids and the glycerol are separated. Glycerol can be obtained also as a by-product in the manufacture of soap.

COPRA CAKE

The residue, after pressing the copra for oil, is called copra meal, or copra cake. It contains about 10 per cent of oil and 17-18 per cent of protein. Copra cake is generally used as cattle and chicken feed. According to Lindsey (1914) its nutritive value is equal to that of gluten feed, and if given in sufficient amount to cows it helps in producing butter which

⁴In order to manufacture cooking fat from coconut oil it is first hydrogenated to harden it, but this result may be accomplished with the use of some animal or vegetable oil of high melting point.

is firm in texture; furthermore, Ewing and Spence (1918) found that butter from copra cake fed cows has a high fat content. In the East Indies, copra meal has been suggested by Jansen (1921) as a useful protein for man when food is scarce. A combination of copra meal and rice bran has been shown by Allas (1924) to be a good supplement to camote vines for feed for growing pigs. However, Sulit (1926) found that if the cake is given in great amounts to rats it acts as poison.

Copra cake is valuable also as a fertilizer. Jaojoco (1923) found that the cake contains 19.89 per cent P_2O_5 and 8.14 per cent K_2O .

COCONUT WATER

The water of the coconut may be used for making fermented beverages; the Filipinos mix the water with corn starch and make vinegar. According to Leonard (1925) coconut water which has been allowed to ferment for four to five days will coagulate rubber latex and produce a rubber of good color and purity.

COCONUT SHELL AND HUSK

Various uses are made of the shell of the coconut. It is often made into bowls for ornamental purposes, into household utensils, carved articles, rubber-tapping cups and stringed instruments. According to the patent of Schwinger (1915) the shell may be used in the manufacture of colored buttons, and the shavings of the shell used for polishing hard colored articles. It is used also in the manufacture of corks. The shell is a good fuel, either as charcoal or untreated. The charcoal when properly prepared is extensively used in the refining of sugar, decolorizing of colored liquids, etc., and as an ingredient in the chemical purifiers in gas masks. It has been used by Shober (1910) as an absorbent in radium therapy. Coconut shell charcoal also serves as a catalyst in the production of alcohols and aldehydes from gaseous hydrocarbons. Kloppenburg (1924) synthesized methyl alcohol and formaldehyde from methane by oxidizing the hydrocarbon in the presence of coconut charcoal.

When a mixture of shell and coconut husk is subjected to distillation, an acid liquid is distilled. This distillate has been found by Stevens (1921) to coagulate rubber. When the shell or the husk is burned, it produces an ash rich in soda, potash, and phosphoric acid. Hence, the ash may serve as a source of alkali in the manufacture of soap or as a constituent of fertilizers.⁵

From the husk, coir fibers that can be used in the manufacture of rope, twine, matting, rugs, and carpet, and also for brushes and brooms and mops may be made. It has been calculated by Holonesky (1926) that from 1000

⁵ As found in the College Experiment Station Laboratory, the ash of the shell contains 5.80% Na_2O ; 23.5% K_2O ; and 4.96% P_2O_5 , and that of the husk contains 2.29% Na_2O ; 30.19% K_2O ; and 5.94% P_2O_5 .

husks, 60 kilograms of spinnable fiber and 7.5 to 12.5 kilograms of stuffing fiber may be obtained. The spinnable fiber can be used, according to Von Uffel (1919), in manufacturing fire-proof roofing. There are a number of uses for the coir fiber. It is used in the place of hemp in the manufacture of rope and twine. Cordage made from the coir stands exposure to weather and water better than that made from some other fibers. The coir is also used for making door mats and floor mops. According to Sampson (1923), coir fiber is even made into belting for driving machinery. The stuffing fibers may be used in the manufacture of corks. The possibility of using coconut fiber as a raw material for some classes of paper or paper pulp has been suggested by Richmond (1906). The fibers also serve as a good fuel and for stopping of leakage.

THE FLOWER SPATHE

In many localities the coconut is raised not for the nuts but for the flower spathe. This, on being cut properly, yields toddy which may be used as a beverage, either fresh or fermented, or it may be made into syrup, palm sugar, or vinegar.

SUMMARY

The coconut products which are very much in demand at the present time are oil, copra, copra cake, and desiccated coconut. During the world war, coconut charcoal was extensively utilized in making gas masks, and with proper preparation it may be used for refining sugar. The sap from the spathe is extensively used in making fermented beverages. In passing, it may be pointed out that at the present price of the fermented drink in the Philippines, it is more than twice as profitable to cultivate the coconut for the toddy than for the copra. Coconut coir is used in the manufacture of cordage and upholstery.

It would be interesting to find out whether the system practiced in the sugar centrals as applied to sugar production cannot be applied in coconut plantations. Conditions under which copra is handled make the price of the oil relatively much higher than if it were obtained directly from the fresh nuts. These conditions are: under the present method of handling copra for export a large percentage of the oil is lost in transit owing to the action of molds; the inconvenience of handling copra because of the impurities, such as sand, nails, etc., deliberately thrown in by the middlemen; and that in order to get high grade oil, refining is necessary. The main difficulty in obtaining the oil from fresh coconut meat seems to be the lack of knowledge about the method of separating the protein colloids from the oil.

Other important investigations that may be carried out with profit are the utilization of copra cake for fertilizer and food, and the manufacture of charcoal for sugar refining from coconut shell.

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PATHOLOGICAL LESIONS CAUSED BY AN UNDESCRIBED COOPERIA IN A CARABAO¹

A. K. GOMEZ

Of the College of Veterinary Science

WITH ONE PLATE

In the course of an experiment on tuberculosis in carabaos (*Bubalus bubalus*), an unusual case of intestinal parasitism caused by an apparently undescribed species of nematode was discovered by the writer. A piece of the intestinal wall preserved in Kaiserling was sent for identification to Dr. Benjamin Schwartz of the United States Bureau of Animal Industry. In his answer to the writer, Doctor Schwartz expresses the belief that the parasite concerned belongs to an undescribed genus *Cooperia*.

For the purpose of recording the pathological lesions caused by this parasite in the carabao the following protocol is submitted.

HISTORY

On August 30, 1926, six young carabaos were obtained for experiments on tuberculosis. One of these carabaos, No. VI, one and a half years old, which was given intravenously five milligrams of a culture of *Mycobacterium tuberculosis* suspended in 2 mls of 1-10,000 sterile solution of sodium carbonate, became extremely emaciated. On May 20, 1927, this animal was found to be too weak to support its own weight. So it was decided to kill it with 15 mls of tincture of nux vomica injected intracardially.

MORBID ANATOMY

On autopsy, the following lesions were found:—The blood was pale and watery; there were marked and extensive serous infiltrations of the subcutis, mesentery, and peritoneum; the fat on the coronary region of the heart, the pelvis of the kidney, and mesentery had a gelatinous appearance; the spleen, liver, kidneys, and heart muscle were atrophied and pale; the lungs were pale and crepitant; the most conspicuous lesion consisted in the presence of numerous parasitic nodules throughout the mucous membrane of the small intestine, starting from a few centimeters from the pyloric end of the stomach and extending to the entrance of the ileum into the caecum. These nodules were numerous at the duodenum and jejunum and fewer in number toward either end of the small intestine. They were at first taken for tubercle nodules, but on close inspection the error was apparent. They were found to be 4 mm. in diameter, 2 mm. in height protruding into the

¹Experiment Station contribution No. 542. Received for publication May 28, 1928.

lumen of the intestine. There was a pin point opening in the center. (See plate I.) Upon carefully teasing out the fibrous capsule of a nodule in salt solution, a small, slender nematode coiled upon itself was liberated.

No evidence of tuberculosis was observed in any of the organs of the carcass. Histological examination of sections of these nodules revealed that they were composed of a fibrous connective tissue capsule within which a cross-section of the parasite could be seen. Inside this capsule numerous young fibroblasts and lymphocytes could be seen surrounding the parasite. In some places, the fibroblasts appear in reticular strands. The mucosa immediately opposite the nodule was atrophied because of pressure, and in some nodules the intestinal glands had undergone necrosis and disappeared. There was a marked lymphocytic infiltration of the mucosa and adjoining tissues.

It is probable that the worm pierces the mucous membrane of the intestine at the pin point opening on the surface of the nodule and its progress through the wall of the intestine is stopped by the muscularis as the local tissue reactions do not extend beyond this layer.

EPICRISIS

The cause of death was due to inanition. The presence of numerous parasitic nodules throughout the mucosa of the small intestines and the degeneration of the intestinal glands impaired digestion and assimilation, resulting in extreme emaciation and death.



PLATE 1.—Portion of small intestine of carabao showing parasitic nodules.
X a nodule showing pin point opening.

EFFECTS UPON RICE PLANTS OF CHANGING THE MOISTURE CONTENT OF SOIL¹

FELICIANO T. PANTALEON

INTRODUCTION

Rice plants, especially the lowland variety, need much water for proper growth and development and are known to be affected materially by drought and lack of sufficient water in the soil.

Investigations on relation of water to rice have been carried out in different countries, but for the most part on water requirements of rice plants and on the effect of different depths of submergence. A review of available literature failed to find any study on determining how far healthy young rice plants can endure a sudden reduction in the supply of moisture in the soil, and what the ultimate effects of this condition would be upon the yield of straw and grain, should the plants be supplied again with sufficient water until complete maturity.

Previous studies on water requirements and on the effects of submergence will not be reviewed here as they are not directly related to the present study. The two available reports somewhat concerned with the subject are only abstracts. One reports that Hellriegel *et al* as cited by Pfeiffer *et al* (1920) found that intercalated waterings when water was lacking in the soil were harmful to plants. These authors found also that even a large amount of water supplied to the plant during a period of drought was not sufficient to repair the injury which the plant had received. The other study, also cited by Pfeiffer *et al* in their report, is that of Gain, who is reported to have observed that a certain quantity of water applied to the soil after a slight drought gave better results than the continuous supply of moisture, even when this was at an optimum amount.

Object of the present study

The objects of this study were: (1) To determine how far rice plants can endure the lack of sufficient moisture in the soil; and (2) to determine how far the rice plants so treated can recover should they be supplied again with water in sufficient quantity.

Time and place

This investigation was begun on June 18, 1927, and was closed on December 23, 1927. It was carried out near the Plant Physiology Depart-

¹ Thesis presented for graduation, 1928, with the degree of Bachelor of Agriculture from the College of Agriculture No. 266; Experiment Station contribution No. 543. Prepared in the Department of Plant Physiology under the direction of Dr. Rafael B. Espino.

ment, College of Agriculture, Los Baños, under an improvised portable shade which protected the cultures from the rain.

MATERIALS, METHODS, AND RESULTS

Two varieties of rice were grown in 96 pots containing clay loam soil. They were Inintiw variety, which can be grown under upland and lowland conditions (Abesamis, 1921); and Macan Kumpol, a lowland rice. Twenty-four cultures were employed for each variety, or forty-eight cultures in all. For convenience in reference, the two sets of cultures are here designated as the "lowland set" and the "upland set".

Five selected seeds were sown in each pot. Quite uniform germination was obtained. Later, the seedlings were thinned to three uniform plants which were properly watered and exposed to the sun whenever the day was clear. This treatment was continued until the end of forty days. Then, with the exception of two cultures in each set, the supply of water of the cultures was discontinued. The two cultures in each set that received a continuous supply of water were employed as the control, or for comparison. After ten days, two pots from the upland set and two pots from the lowland set were again supplied with water every day until the cultures were harvested. Water was further withheld from the rest of the cultures, and was again given to them only after 17, 24, 31, 38, 45, 52, 59, 66, 73 and 80 days. Two cultures from each variety set were given the same treatment. Further explanation on how the treatments were given the cultures may be found in tables 1, 2, 3, and 4. With the exception of the cultures II, samples of the soil in each pot were taken and their moisture content determined by ordinary gravimetric method.

Two other sets of cultures were started. The materials and methods employed were quite similar to those employed in the first two culture sets. However, there was a slight change in the method. In these two sets, the pots were put on pieces of wood so that they were about three centimeters above the ground instead of being on it as in the first two sets of cultures. The period from the time the supply of water was cut off to the time when water was again supplied was made shorter. In the first two sets, the intervals were seven days, and in the later sets the intervals were made only five days. This change was made due to the fact that many of the plants in the first sets of cultures died owing to prolonged withholding of water. The cultures in these sets were supplied with water daily for thirty days,—one liter of water to each culture in the upland set and two liters to each pot in the lowland set. In the lowland set, the surface of the soil in each culture was submerged to a depth of three centimeters; while the soil in the pots in the upland set was kept only moist. At the end of thirty days, except in two cultures from each set, the supply of water to the pots was cut off entirely. However, five days later, two cultures from each set were again supplied with water daily until maturity. The other cultures received,

again, water daily beginning ten days, fifteen days, etc. (see tables 3 and 4) from the time water was withheld entirely until maturity. The two cultures from each set that received water daily until maturity of the plants served as control.

Observations were made from time to time on the general vigor of the plants in the different cultures. The date of blooming and date of maturity of the grain were noted. At the time water was withheld, the height of each plant in the different cultures was measured from a certain base mark at the level of the soil in the pot to the tip of the highest leaf. At maturity before the plants were harvested, the height was again measured from the base mark to the tip of the "boot" leaf. The grains and straw harvested separately from each culture were dried in the room and then air-dry weights were determined. The experimental data thus obtained are shown in tables 1, 2, 3, and 4. Some of these figures are averages and were obtained under the following criteria:

a. Average height of plants at the time water was withheld. The height of each plant in each culture was measured from a base mark to the tip of the highest leaf. The heights of the three plants in each culture were added and the average height found by dividing the sum by three.

b. Average height of plants at harvest. Following the method employed in (a), the heights of the three plants in each culture were determined at the time of harvest. The data thus obtained were added together and divided by three. The quotient is the average sought.

c. Average increase in height from the time water was withheld until harvest. The numerical data under this criterion were obtained by subtracting the data in (b) from the corresponding data in (a).

d. Air-dry weights of straw and grain. The method which was followed in obtaining the data under these criteria is described under "Materials, methods, and results."

e. Number of days to maturity. This is the number of days from the time the seeds were sown to the day when the plants in each culture were harvested.

Weather observations were also made. As recorded by a thermograph which was placed near the cultures, the maximum air temperature ranged from 27°C. to 32.5°C. during the day; the minimum from 22.6°C. to 25.5°C. during the night.

An improvised movable shade (V-shaped) made of bamboo frame and thatched with nipa, protected the cultures from rain. This shade was made so it could slide on three bamboo parallel beams placed horizontally one meter above the ground. As records on precipitation are not here needed they are not included.

Whenever the sky was clear the plants were directly exposed to the sun. Of course, on rainy or cloudy days the plants received only diffused

sunlight. On the whole, however, the cultures received a normal supply of sunlight during the entire culture period.

DISCUSSION OF RESULTS

The results from this study are here presented in two parts: (a) those from the first plantings, and (b) those from the second plantings. The observations made on the external appearance of the plants from both plantings are given under one heading.

External appearance of plants

The plants in the different cultures in which the water supply was cut off for different lengths of time behaved differently. Some of the plants were injured severely, as shown by drying of leaves; while others were apparently not affected at all. While the plants in cultures IIa and IIb of the upland set and the lowland set in both plantings did not suffer at all from the lack of moisture in the soil when the supply of water was cut off only for five or ten days, the other cultures whose water supply was cut off for a longer period of time suffered materially, resulting in the death of the plants in some extreme cases. The plants in cultures IIIa and IIIb and in the rest of the cultures felt the insufficiency of moisture in the soil, as was shown by rolling of the leaves followed by drying of tips and complete drying of some leaves at the base. The rolling or folding of the leaves was noticed on the twelfth day from the time the supply of water was cut off. Early in the morning, however, the leaves of the plants were found open again, but they began to roll as the day advanced. This condition of the leaf remained for some time but finally a marked drying of the leaves took place (see tables 1 to 4). From these observations on the external appearance of the plants, it becomes evident that cutting off of the usual supply of water from the soil, if water is supplied again in five to ten days, proved not only that it was not harmful to the plant, but even stimulating, as the plants so treated, later on, became more thrifty than those in the control cultures. These observations confirm those of Gain, as cited by Pfeiffer *et al* (1920), who is reported to have observed that a certain quantity of water supplied to the soil after slight drought gave better results than the continuous supply of moisture, even when this was at an optimum amount.

Straw and grain from first plantings

As shown in tables 1 and 2 the results obtained from the duplicate cultures were quite similar. For this reason, the data under the same criterion in tables 1 and 2 were averaged and the results are recorded in table 5. This procedure was followed for both the lowland set and the upland set.

The upland set. Examination of the data in table 5 shows that the average heights of the plants at harvest were different,—indicating that the methods of watering had material influence on the growth in height of the plants in the different cultures. Under this criterion, the control plants

which received a continuous supply of water were not any better than those which were deprived of the optimum amount for a period of ten days, confirming again the results obtained by Gain. A difference of 16 per cent in favor of the latter culture is shown in table 5. The cultures whose optimum water supply was withheld for 17, 24, and 31 days produced plants much shorter than those of the control. The plants grown in the cultures that were deprived of the usual supply of water for a period of not less than 38 days, died.

The yield of straw was also affected by the amount of water supplied to the plants. As shown in table 5, culture II, in which the 40-day old plants were deprived of the usual amount of water for 10 days, not only regained their former vigor but they even excelled the plants that were continuously supplied with water from the start until maturity. The yield of straw also dropped materially in cultures in which the water supply was cut off for 17, 24 or 31 days. The straw of the plants that did not revive when water was supplied to the soil was not collected (table 5).

The yield of grain was greatest in culture II, in which the plants were deprived of the normal supply of water for 10 days. In this culture, the yield of grain was 80 per cent more than that from the control (table 5).

Lowland set. The height of the plants in culture II of this set was 12 per cent higher than that of the control. The plants from the other cultures deprived of water for a period longer than 10 days were shorter than those that received water continuously (control) or were deprived of it for only ten days (table 5).

The effects on the yield of straw and grain were similar to those on growth in height. The weight of straw produced by culture II was 37 per cent more than that of the control. The control, however, produced more straw than any of the cultures that were deprived of the usual amount of water for a period of not less than 17 days.

The weight of grain produced by culture II was 44 per cent higher than that of the control; that of the culture III, 10 per cent higher; and that of cultures IV and of V, lower.

As in the upland set, the cultures from the lowland set that were deprived of the usual supply of water for a period of not less than 38 days all died; none revived when water was supplied again.

Straw and grain from second planting

As shown in tables 3 and 4, the results obtained from the duplicate cultures are very much alike. The averages of these results are shown in table 5.

The upland set. The average heights of the plants at harvest (see table 5) were different. The results indicate also that the methods of watering had material influence on the growth in height of the plants in the different cultures. The control plants, which received a continuous supply of

water, differed in height from those which were deprived of the usual amount of water for a period of 5 days, 10 days and 15 days by 3, 17, and 7 per cent, respectively, in favor of the last three cultures. The cultures whose usual water supply was withheld for 20 and 25 days produced plants which, in height, were less than those of the control by 8 per cent and 23 per cent, respectively. The effect of the amount of water supplied to the plant was also exhibited by the yield of straw. In culture II in which the plants 30 days old were deprived of water for 5 days and in culture III for 10 days, the weight of the straw produced was 6 per cent and 34 per cent, respectively, above that of the control plants. The plants of the cultures deprived of usual water for 15, 20, and 25 days produced weight of straw below that of the control plants.

The yield of grain was also affected by the methods of supplying the water in the same manner that growth in height and the yield of straw were affected. The plants in cultures II and III produced weight of grain 58 per cent and 102 per cent, respectively, greater than that of the control; while cultures IV, V, and VI produced weight of grain less than that obtained from the control plants.

Lowland set. The effects produced by the methods of supplying the water to the plants in the lowland set were similar to those obtained from the upland set. The height of the plants in cultures II and III were, respectively, 3 per cent and 14 per cent more than that of the control plants; while in the rest of the cultures the height was less. The good and the bad effects of this method of supplying the water were also exhibited by these cultures in the yield of straw and grain. The weight of straw produced by culture II was 9 per cent, that of culture III, 32 per cent higher than that of the control plants; while the weight from the rest of the cultures was in each case less than that of the control. The grain produced by culture II was 7 per cent and that of culture III, 37 per cent higher than that produced by the control plants. The rest of the cultures, that is, those that were deprived of the usual supply of water for a period of not less than 15 days either failed to revive when water was again supplied to the pots, or revived somewhat, only to produce much less grain than was produced by the control cultures.

Number of days to maturity

As shown in tables 1 to 4 inclusive, the number of days from the day the seeds were sown in the pots to complete maturity of the grain which was produced by the plants varied considerably in different cultures. However, withholding water for five to ten days did not at all change the length of period to maturity as compared with the control. But, as the reduction of the water supply was much prolonged before water was again supplied, the period of development of the plant was also greatly prolonged; in no case should the rice plants 30 or 40 days old be deprived of water for 35 days, as this treatment always proved fatal to the plants.

Effects of treatment upon the upland and lowland rice compared

It might be expected that the upland rice would endure the lack of sufficient moisture in the soil longer than the lowland rice. However, the results of this investigation (see table 5) do not seem to show any material difference; the upland and lowland rice exhibited equal response to lack of moisture in the soil. The data in table 5 show that both the lowland and the upland rice, 30 or 40 days old, when deprived of water longer than 31 days, failed to revive even when water was again supplied in sufficient amount. Moreover, as discussed elsewhere in this report, the plants in both varieties that were deprived of the usual supply of water for a period of five or ten days, produced better results than those produced by the control, in which water was supplied continuously. It is, therefore, quite evident that upon the upland and lowland rice the effects of the treatment were alike.

SUMMARY AND CONCLUSIONS

1. The rice plants in pots, 30 or 40 days old, that were deprived of sufficient water for a period not longer than 15 days, when again supplied with water gave better results, under the criteria of height and yield of straw and grain, than those which were continuously supplied with water from the start to maturity.

2. Although the plants, 30 or 40 days old, that had been deprived of the usual supply of water for 17 to 25 days survived the treatment when again supplied regularly with water till maturity, their yields of straw and of grain were much less than those obtained from the control plants, which were supplied with water continuously.

3. The plants, 30 or 40 days old, from the cultures in which the usual supply was cut off for a period of not less than 38 days, died.

4. Withholding water for 5 to 10 days did not alter the length of period to maturity of the rice plants, as compared with the control in which water was supplied regularly until maturity.

5. The rice plants, 30 or 40 days old, deprived of water for 35 days or more, failed to revive although they were again supplied with sufficient water.

6. The effects upon both the upland and the lowland varieties of rice used, of withholding water from the pots, were quite similar.

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TABLE 1

Showing data obtained from rice cultures in which the seeds were sown on June 18, 1927, and the young plants were allowed to develop normally for 40 days or until July 28, 1927. Thence, except the control, the watering was stopped but was resumed after a certain number of days as shown in the table

Inintiw (upland rice)

CULTURES IN DUPLICATES	INITIAL DATA			RESULTS OF EXPERIMENTS				
	Number of days water was not supplied to the plants	Moisture content of soil before water was supplied	Average height of plants at the time water was withheld	Average height of plants at harvest	Average increase in height from the time water was withheld until harvest	Air dry weight		Number of days to maturity
						Straw	Grain ^a	
Ia	Control	per cent	cm. 45.43	cm. 88.6	cm. 43.2	grams 15.7	grams 4.2	117
Ib			41.50	84.1	42.6	13.8	3.8	
IIa	10	b	46.33	101.1	54.7	21.2	8.2	117
IIb			43.60	96.7	55.1	18.4	6.2	
IIIa	17	19	45.00	78.3	33.3	11.9	3.3	130
IIIb		17	42.40	75.3	32.9	9.3	2.6	
IVa	24	16	48.83	62.5	13.6	7.9	2.3	144
IVb		14	43.10	59.8	16.7	5.9	1.8	
Va	31	15	45.33	59.2	13.8	6.3	2.1	144
Vb		13	47.50	56.6	9.1	5.5	1.6	
VIa	38		40.80	Dead				
VIb			44.30					
VIIa	45		45.23	Dead				
VIIb			41.23					
VIIIa	52		42.50	Dead				
VIIIb			43.10					
IXa	59		44.00	Dead				
IXb			46.50					
Xa	66		43.46	Dead				
Xb			43.83					
XIa	73		45.83	Dead				
XIb			42.33					
XIIa			41.53	Dead				
XIIb			44.53					

^a Empty and full grains were weighed together.

^b Moisture content of the soil not determined.

TABLE 2

Showing data obtained from rice cultures in which the seeds were sown on June 18, 1927, and the young plants were allowed to develop normally for 40 days or until July 28, 1927. Thence, except the control, the watering was stopped but was resumed after a certain number of days as shown in the table

Macan Kumpol (lowland rice)

CULTURES IN DUPLICATES	INITIAL DATA			RESULTS OF EXPERIMENTS				
	Number of days water was not supplied to the plants	Moisture content of soil before water was supplied	Average height of plants at the time water was withheld	Average height of plants at harvest	Average increase in height from the time water was withheld until harvest	Air dry weight		Number of days to maturity
						Straw	Grain ^a	
Ia	Control	per cent	cm. 44.33	cm. 75.83	cm. 31.50	grams 13.2	grams 2.7	135
Ib			40.43	91.90	31.47	11.8	2.5	
IIa	10	b	46.43	92.06	45.63	19.0	4.2	135
IIb			43.43	72.70	29.27	15.2	3.3	
IIIa	17	19	45.46	67.53	22.07	10.0	3.5	148
IIIb		18	40.53	61.50	20.97	8.1	2.2	
IVa	24	16	47.26	64.36	17.10	7.7	2.8	163
IVb		16	44.03	60.46	16.43	6.5	1.9	
Va	31	14	45.00	60.96	15.96	6.7	1.8	163
Vb		13	41.33	60.26	18.93	5.9	0.9	
VIa	38		42.83	Dead				
VIb			41.76					
VIIa	45		41.66	Dead				
VIIb			43.53					
VIIIa	52		44.33	Dead				
VIIIb			40.80					
IXa	59		42.56	Dead				
IXb			40.53					
Xa	66		40.30	Dead				
Xb			38.76					
XIa	73		43.20	Dead				
XIb			46.16					
XIIa	80		41.13	Dead				
XIIb			49.16					

^a Empty and full grains were weighed together.

^b Moisture content of the soil not determined.

TABLE 3

Showing data obtained from rice cultures in which the seeds were sown on July 17, 1927, and the young plants were allowed to develop normally for 30 days or until August 16, 1927. Thence, except the control, the watering was stopped but was resumed after a certain number of days as shown in the table

Inintiw (upland rice)

CULTURES IN DUPLICATES	INITIAL DATA			RESULTS OF EXPERIMENTS				
	Number of days water was not supplied to the plants	Moisture content of soil before water was supplied	Average height of plants at the time water was withheld	Average height of plants at harvest	Average increase in height from the time water was withheld until harvest	Air dry weight		Number of days to maturity
		per cent	cm.	cm.	cm.	grams	grams	
Ia	Control		33.66	78.56	44.90	10.3	3.4	114
Ib			28.93	70.46	41.53	8.6	3.2	
IIa	5	b	34.23	79.36	45.13	10.7	5.8	114
IIb			32.70	74.26	41.56	9.4	4.6	
IIIa	10	32	40.50	92.26	51.76	14.2	7.8	114
IIIb		28	34.26	82.50	48.24	11.2	5.5	
IVa	15	18	33.50	80.56	47.06	10.2	3.4	129
IVb		17	39.76	78.40	38.64	7.8	2.7	
Va	20	15	34.36	71.33	36.97	8.2	1.8	142
Vb		15	29.30	65.60	36.30	6.6	1.5	
VIa	25	13	32.36	59.66	27.30	5.2	1.5	142
VIb		13	30.53	55.40	24.87	4.4	0.8	
VIIa	30		33.10	Dead				
VIIb			35.56					
VIIIa	35		33.70	Dead				
VIIIb			35.10					
IXa	40		34.06	Dead				
IXb			35.73					
Xa	45		34.33	Dead				
Xb			30.10					
XIa	50		35.30	Dead				
XIb			36.06					
XIIa	55		38.13	Dead				
XIIb			33.96					

^a Empty and full grains were weighed together.

^b Moisture content of the soil not determined.

TABLE 4

Showing data obtained from rice cultures in which the seeds were sown on July 17, 1927, and the young plants were allowed to develop normally for 30 days or until August 16, 1927. Thence, except the control, the watering was stopped but was resumed after a certain number of days as shown in the table

Macan Kumpol (lowland rice)

INITIAL DATA				RESULTS OF EXPERIMENTS				
CULTURES IN DUPLICATES	Number of days water was not supplied to the plants	Moisture content of soil before water was supplied	Average height of plants at the time water was withheld	Average height of plants at harvest	Average increase height in from the time water was withheld until harvest	Air dry weight		Number of days to maturity
						Straw	Grain ^a	
Ia	Control	per cent	cm.	cm.	cm.	grams	grams	131
Ib			36.16	80.40	44.24	16.1	4.8	
IIa	5	b	34.63	78.30	43.67	13.4	3.5	131
IIb			32.73	83.40	50.67	18.3	5.2	
IIIa	10	34	38.13	80.46	42.33	13.9	3.6	131
IIIb			36.56	95.26	58.70	22.0	7.3	
IVa	15	30	35.30	85.36	50.06	16.9	4.1	148
IVb			33.56	75.36	41.80	9.5	2.7	
Va	20	19	33.50	68.30	34.80	7.7	2.2	159
Vb			32.60	64.43	31.83	8.6	2.5	
VIa	25	15	37.00	65.46	28.46	7.2	1.9	159
VIb			38.86	61.96	23.10	6.6	1.5	
VIIa	30	14	40.53	60.36	19.83	6.1	1.5	159
VIIb			34.10	Dead				
VIIIa	35		34.96	Dead				
VIIIb			31.53	Dead				
IXa	40		32.43	Dead				
IXb			31.86	Dead				
Xa	45		32.50	Dead				
Xb			34.40	Dead				
XIa	50		32.50	Dead				
XIb			34.36	Dead				
XIIa	55		37.00	Dead				
XIIb			30.90	Dead				
			32.10					

^a Empty and full grains were weighed together.

^b Moisture content of the soil not determined.

TABLE 5
Averages of data in tables 1 and 2 and those in tables 3 and 4, expressed in "relative values" a

PLANTING, JUNE 18, 1927				SECOND PLANTING, JULY 17, 1927										
e)	Macan Kumpol (lowland rice)					Number of days water was not supplied	Inintiw (upland rice)				Macan Kumpol (lowland rice)			
	Air dry weight of grain	Height of plants at harvest	Air dry weight of straw	Air dry weight of grain			Height of plants at harvest	Air dry weight of straw	Air dry weight of grain		Height of plants at harvest	Air dry weight of straw	Air dry weight of grain	
100	(4.0 grams)	100	100	100	Control	(74.5 cm.)	100	100	100	100	100	100	100	100
180		112	(12.5 grams)	(2.6 grams)		103	106	(3.3 grams)	(79.4 cm.)	158	103	109	(14.75 grams)	(4.15 grams)
74		87	137	144	5	117	134	202	114	202	114	132	137	107
51		85	57	90	10	107	95	92	91	92	91	58	59	137
46		82	50	52	15	92	78	50	82	50	82	54	53	59
		Dead			20	77	58	35	77	35	77	43	36	36
		Dead			25	Dead			Dead		Dead			
		Dead			30	Dead			Dead		Dead			
		Dead			35	Dead			Dead		Dead			
		Dead			40	Dead			Dead		Dead			
		Dead			45	Dead			Dead		Dead			
		Dead			50	Dead			Dead		Dead			
		Dead			55	Dead			Dead		Dead			

riety taken as 100; the results were reduced relatively.

CULTURES	FIRST		
	Number of days water was not supplied	Initial (upland rice)	
		Height of plants at harvest	Air dry weight of straw
I	Control	100	100
		(86.4 cm.)	(14.75 grams)
II	10	116	134
III	17	89	71
IV	24	71	47
V	31	67	40
VI	38	Dead	
VII	45	Dead	
VIII	52	Dead	
IX	59	Dead	
X	66	Dead	
XI	73	Dead	
XII	80	Dead	

^a The actual value for the control was arbitrary.

PLOWING UNDER LEGUMES BY THE USE OF SINGLE-ANIMAL PLOWS¹

CHARAS S. SUNDARASINHA

INTRODUCTION

One reason green manuring is not a usual practice in the Philippines, and possibly in other tropical countries also is that most of the farmers cannot afford to buy expensive implements with which to plow under green vegetation effectively. Another reason is that some farmers do not know the value of turning under green manures. The aim of the present work was to find a way by which legumes or green trash can be plowed under effectively with the single-animal native plow and cutter.

The work was performed from June 1927, to February, 1928, in an assigned lot adjacent to the railroad line in the Experiment Station of the College of Agriculture

MATERIALS AND METHODS

Description of implements

Roller cutter. This implement was recently devised by Professor M. B. Raymundo of the Agronomy Department. It consists of six circular steel disks each 32 centimeters in diameter and 3 millimeters thick, with sharp edges. These disks are mounted $15\frac{1}{2}$ centimeters apart on an iron axle 3 centimeters in diameter. A pair of bamboo shafts are attached, one to each end of the axle; to the other ends of the shafts a wooden yoke is fastened by tying.

Bolo cutter. This device consists of five bolo blades, or working knives inserted 10 centimeters apart in slots made in a thick wooden rectangular plank $65 \times 40 \times 6$ centimeters in size. The blades are held in place by means of wooden wedges.

Native plow. In this plow the moldboard, of cast iron, is 30 centimeters in length. The share, also of cast iron, is 30 centimeters along the median line from vertex to the base. The beam is made of wood and is 170 centimeters in length. The landside is 56 centimeters in length. The handle is made of wood.

The average cut is about 15 centimeters. The average depth is about 10 centimeters. There is practically no adjustment as to width of cut and very little as to depth.

¹ Thesis presented for graduation, 1928, with the degree of Bachelor of Science in Agriculture from the College of Agriculture, No. 267; Experiment Station contribution No. 544. Prepared in the Department of Agronomy under the direction of Assistant Professor Mariano B. Raymundo.

For purposes of comparison the following data are given:

Chattanooga Reversible Disk Sulky Plow (Standard)

Disk—50.8 centimeters in diameter.

Average cut—30 centimeters.

Average depth—15 centimeters.

John Deer Prairie Queen Breaker Plow (Standard)

Average cut—30 centimeters.

Average depth—15 to 18 centimeters.

Chattanooga Stubble Plow

Average cut—30 centimeters.

Average depth—15 to 18 centimeters.

Luzon Lagio-single-animal-steel Plow

Average cut—15 centimeters.

Average depth—10 centimeters.

Description of the legumes used

The legumes used in the study were New Era cowpea, Ami soybean, and mungo.

Mungo (Phaseolus mungo). Mungo was used to represent the dwarf type of legumes. It has a thinner growth and finer texture than cowpeas or soybean. Mungo, according to Sornay (1916), is upstanding in character, ranging from 50 centimeters to one meter in height. The leaves are similar to those of common beans and are hairy and wrinkled. The yellowish green flowers arise in pairs at the extremity of the common peduncle which springs from the leaf axils and rises above it.

At the time this plant was turned under its height was about 85 centimeters and the flowers were beginning to open. Mungo grown during rainy season produces an abundance of vegetative parts but seldom any pods. As a green manure crop, according to Sornay (1916), it is a fast grower and within a period of one month it can be plowed under.

New Era cowpea (Vigna sinensis). The cowpea was used to represent the viny legumes. It grows best in warm climates. In the early part of its growth, it is more or less erect, but as it approaches maturity it tends to lodge. The characteristics of New Era cowpea, according to Morse (1924), are: half bushy, prolific; pods held high; seeds buff, thickly and evenly speckled with blue. Cowpea, according to the same author, has been used as a soil renovator more than any other legume because it can be grown easily on almost any kind of land, provided it is not too wet. The crop when used as green manure is beneficial. Its beneficial effects last two or three seasons if it is followed by such crops as corn, cotton or small grains.

Cowpea planted during the rainy seasons tends to produce vine rather than its usual bushy characteristics and has a tendency to entwine forming a "mat". At the time the cowpea used in this experiment was plowed under, the "mat" was about 45 centimeters thick.

Ami soybean (Glycine hispida). Soybean was used in this experiment to represent the woody legume. According to Evans and Fowlds (1921), it is erect, ranging from 30 centimeters to one meter in height. The stem

is hairy. The leaves are trifoliate; flowers are abundant, borne in clusters from the axils of the leaves.

At the time the soybean that was used in this experiment was plowed under, the average height was about 90 centimeters.

Description of the field used

The condition of the field during the experiment was fairly uniform. The soil is sandy loam, mellow, friable, has plenty of humus. It is best for plowing when it can be molded by hand and crumbled even with a slight pressure.

Procedure followed

The field was prepared by thorough plowing and harrowing. It was then divided into three equal lots, each 83.0×60.4 meters. On the first lot, mungo was broadcasted; on the second lot, cowpea; and on the third lot, soybean. After planting, the whole field was harrowed to cover the seeds.

A few days later, when the seeds began to sprout, the stand of each legume was taken; the result is recorded in table 2. This record was made to show that the stand was about average.

When the field was in the right condition for plowing, it was divided lengthwise into seven equal lots, each 11.8×181.2 meters, so that the three representative legumes would be included in each lot. The reason for this was that the same operation could be carried on each legume at the same time.

In each trial, the implements used were drawn across the field lengthwise, using a bullock as motive power.

The effects of the different implements were noted and recorded and photographs (not presented in this paper) were taken at the time to corroborate and clarify the written record. The different treatments on each lot are tabulated in table 3.

DISCUSSION OF RESULTS

The Chattanooga stubble plow could not turn under legumes effectively because the three bullocks which were used as motive power were not fast enough to throw the furrow slice over; there was a tendency for it to roll back to its original position. It was noted that if the stubble plow is drawn by a tractor, the furrow slice turns over well. Hence, speed is an important factor in the turning over of the furrow slice. The ideal speed for a tractor to draw a plow was found to be about $4\frac{1}{2}$ kilometers an hour. The speed of the bullock varies; according to Teodoro (1925), it varies from 0.8 to 2.0 kilometers an hour. For this reason a good turning under of legumes or trash with the stubble plow cannot be expected when it is drawn by bullocks. The same condition was found to be true with J. D. Prairie Queen Breaker plow.

The reversible disk plow, drawn by three bullocks, excelled in effectiveness both the J. D. Prairie Queen Breaker plow and the Chattanooga stubble plow. This superiority may be attributed to the fact that the make-up of the disk plow renders a possible lighter draft than that of the Chattanooga stubble plow or the J. D. Prairie Queen Breaker plow, both of which are moldboard plows. This difference in make-up may make it possible for the bullocks to pull the plow at such a speed that it will turn under effectively trash or legumes.

The Luzon Lagio plow was not effective in the turning under of trash or legumes. This may be attributed to several factors. One is that its moldboard is more like that of a stubble plow than of a breaker plow, though it serves as a dual purpose plow or mid-way between a stubble plow and a breaker plow. Furthermore, its share is of chilled steel and has the tendency to scour. Also, it is heavier than the native plow, consequently, a bullock cannot pull it fast enough to make the act of turning under of legumes or trash effective. According to Teodoro (1925), with the Luzon Lagio plow the furrow bottom cannot be cut entirely off while plowing, and a further defect is its poor work in turning a furrow slice which often tends to roll back to its original position. Trials were made with and without the combination of the roller cutter, but the results were far from being satisfactory. The native plow not only is light in itself, but is lighter in draft than the Luzon Lagio plow because it is made up of lighter materials, mostly wood; the only heavy part is the plow bottom which is made of cast steel. It looks like a stubble plow.

Philippine farmers prefer the native plow to the Luzon Lagio plow because the plow is assembled in the locality where it is used; thus proper adjustment is made to fit the soil conditions and quality of work to be done (Teodoro, 1925).

In the portions of the field that were treated with the native plow without any previous treatment, much of the legumes was left uncovered. But in the portions which were treated once with roller cutter and then turned under with the native plow, the legumes were partly covered, that is, a little better than where the legumes were plowed under without any previous treatment.

The portions of the lots that were treated first with the bolo cutter and then turned under with the native plow were worse than when the roller cutter was used once. For the bolo cutter has the tendency to roll up the legumes in piles, making it hard for the native plow to turn them under.

The treatment that proved to be the best among the ones tried was the using of the roller cutter twice and then turning under with the native plow. Using the cutter twice, the legumes were cut into smaller parts, theoretically, three inches, but the plants were laid at various angles from the direction of the roller cutter, so, obviously, the cut portions will vary in length. How-

ever, this procedure proved nearly, if not quite, as effective as when the legumes were turned under with the reversible disk plow.

The roller cutter not only cuts the legumes but also cuts into the soil to a depth of about five to seven centimeters, thus facilitating plowing, because the surface of the soil breaks up more easily. The roller cutter will cut out trash or stems not more than two centimeters in diameter.

In cutting the legumes, a sack of sand added to the weight of the driver increases the efficiency of the sharp edges of the disk of the roller cutter. The approximate weight of the driver and the sack of sand in this experiment was 100 kilograms. In case the load was too heavy for one animal, a hitch is provided for two animals. However, only one animal was used throughout this test.

Mungo could be turned under with little effort, for it is erect, less bushy and has tender stems as compared with the soybean and cowpea. Besides the fresh weight of top per square meter was lower than that of cowpea, being about two kilograms per square meter (see table 2).

The cowpea is a viny plant. It tends to lodge on the ground as it approaches maturity. The plowing under of this portion of the field was hard, because of the tendency of the cowpea to form a "mat". Also it is the heaviest producer of all the legumes used, having about three kilograms of tops to a square meter (see table 2). This is another reason it was hard to plow under.

Though soybean producing about two kilograms of tops per square meter (see table 2) has the upstanding character and is, at the same age, the tallest of the legumes used, nevertheless the plowing under of this legume was easier than with cowpea but a little harder than with mungo.

As to comparative costs in plowing under legumes, the use of the roller cutter twice and the native plow is cheaper to use than the reversible disk plow. The native plow with the roller cutter cost ₱8.44 to the hectare, while the reversible disk plow cost somewhere around ₱12 to the hectare. However, the native plow does not turn under the legumes as well as the reversible disk plow, but it answers the purpose. (See table 4.)

SUMMARY OF CONCLUSIONS

1. The turning under of legumes by using the combination of the roller cutter passed twice and the native plow proved to be nearly as effective as the reversible disk plow.

2. The combination of a roller cutter and a native plow is not an expensive operation, hence, it is recommended for a farmer whose capital is small.

3. The handling of a roller cutter in combination with a native plow is so simple that no experience is necessary before using it. This feature should encourage farmers to practice green manuring on their farms.

4. A roller cutter can be made at a moderate price in any local blacksmith shop by supplying necessary materials.

5. Since the roller cutter can cut any size of trash that is less than two centimeters, provided there is a proper load on it, any kind of legumes under this treatment will be satisfactory as a cover crop.

RECOMMENDATIONS

1. For satisfactory use of the roller cutter it is suggested that in case the trash to be plowed under is heavy and thick, more weight should be put on top of the cutter.

2. If one animal cannot pull the roller cutter properly loaded for satisfactory work, it is advisable that two animals be used, as the implement is always provided with an extra hitch in case of emergency.

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TABLE 1
Cost per hectare of preparation of land and of broadcasting seeds

DATE	OPERATION	HOURS TO A HECTARE	COST OF OPERA- TION INCLUDING DEPRECIATION AND INTEREST
			<i>pesos</i>
June 4	Plowing.....	27.0	6.06 ^a
June 8	Harrowing after plowing.....	13.5	3.01
June 9	Harrowing after plowing.....		
June 10	Broadcasting seeds.....	4.0	0.44
June 10	Harrowing to cover seeds after broadcasting....	13.5	3.01
	Total.....	58.00	12.52

Cost of the implement

^a Depreciation per day = $\frac{\text{Maximum number of years that it will last} \times \text{maximum number of days used in one year.}}{\text{Cost of the implement} \times \text{rate per cent interest per year}}$

Interest per day = $\frac{\text{Cost of the implement} \times \text{rate per cent interest per year}}{\text{Maximum number of days used in one year}}$

An example, Native plow:

$\text{P}10.00 \times 3 \text{ days} = \text{P}0.039 \text{ depreciation for 3 days (27 hours)}$
 $5 \text{ years} \times 150 \text{ days}$
 $\text{P}10.00 \times 10 \text{ per cent} \times 3 \text{ days} = \text{P}0.018 \text{ interest for 3 days (27 hours)}$
 150 days
 27 hours
 $\times \text{P}1.00 \text{ (per day)} = \text{P}3.00 \text{ cost of man's labor}$
 $9 \text{ hours (one day)}$
 27 hours
 $\times \text{P}1.00 \text{ (per day)} = \text{P}3.00 \text{ cost of man's labor}$
 $9 \text{ hours (one day)}$

Total cost of operation per hectare including the depreciation and the interest is = $\text{P}0.039 + \text{P}0.018 + \text{P}3.00 + \text{P}3.00 = \text{P}6.06$.

According to Maligaya (1924) "Ten per cent interest per annum is the rate of interest at the bank for the farmers with good security".

According to the same author, "The native plow will last for five years provided that the bottom piece including the share is changed once".

Other depreciation rates and interests of different implements were obtained from the Division of Farm Management, and were computed in the same manner.

TABLE 2
Showing area planted, amount of seed used, average stand of plants, average fresh weight of tops, cost of seed of the three legumes used

LEGUMES USED	AREA BROAD- CASTED	AMOUNT OF SEED USED	AVERAGE STAND PER SQ. M. PLANTS	AVERAGE FRESH WEIGHT OF TOPS PER SQ. M.	AVERAGE COST OF SEED PER LITER	COST OF SEED PLANTED
	<i>sq. m.</i>	<i>liters</i>		<i>kgm.</i>	<i>pesos</i>	<i>pesos</i>
Mungo.....	5013.2	21	35.3	1.9	0.13 1/3	2.80
Cowpea.....	5013.2	21	26.3	2.9	0.13 1/3	2.80
Soybean.....	5013.2	21	15.3	1.8	0.15	3.15

TABLE 3
Treatment on each lot

LOT NO.	IMPLEMENTS EMPLOYED
I	Native plow Native plow in combination with bolo-cutter Native plow in combination with roller-cutter (passing once) Luzon Lagio plow Chattanooga stubble plow J. D. Prairie Queen Breaker plow Reversible disk plow
II	Native plow in combination with bolo-cutter Native plow in combination with roller-cutter (passing once) Native plow in combination with roller-cutter (passing twice) Luzon Lagio plow in combination with roller-cutter (passing once) Luzon Lagio plow in combination with roller-cutter (passing twice) Chattanooga stubble plow J. D. Prairie Queen Breaker plow Reversible disk plow
III	Native plow in combination with roller-cutter (passing once) Native plow in combination with roller-cutter (passing twice) Luzon Lagio plow in combination with roller-cutter (passing twice) Reversible disk plow J. D. Prairie Queen Breaker plow Chattanooga stubble plow
IV	Native plow in combination with roller-cutter (passing once) Native plow in combination with roller-cutter (passing twice) Reversible disk plow J. D. Prairie Queen Breaker plow Chattanooga stubble plow
V	Native plow in combination with roller-cutter (passing once) Native plow in combination with roller-cutter (passing twice) Reversible disk plow Chattanooga stubble plow
VI	Native plow in combination with roller-cutter (passing once) Native plow in combination with roller-cutter (passing twice) Reversible disk plow
VII	Native plow in combination with roller-cutter (passing twice) Reversible disk plow

TABLE 4
Cost of operation per hectare of different implements

IMPLEMENTS USED	KIND OF OPERATION	COST OF OPERATION INCLUDING DEPRECIATION AND INTEREST
		<i>pesos</i>
Native plow.....	plowing	6.06
Bolo-cutter.....	cutting	2.23
Roller-cutter.....	cutting	1.21
Reversible disk plow.....	plowing	12.14
J. D. Prairie Queen Breaker plow.	plowing	12.78
Chattanooga Stubble plow.....	plowing	12.58
Luzon Lagio plow.....	plowing	6.05

DOCTOR MANUEL L. ROXAS: AN APPRECIATION¹

The holding of good men in the faculty in competition with commercial enterprises which are able to pay enormous salaries is one of the biggest problems of administration of a college which aims to maintain first class standards. This time it is Dr. M. L. Roxas, Professor and Head of the Department of Agricultural Chemistry, who has left us to accept full time employment with the Philippine Sugar Association. He will be in charge of the experimental work for the association in Luzon, a position which he has been holding on part time for the last three years. Doctor Roxas felt sufficiently heroic to shoulder the work of two positions, each one of which was large enough for one big man to carry, but the overload was too much to bear indefinitely.

Doctor Roxas was among the very first students of the College and stood first among its first three graduates. He has been connected with the institution since its foundation. He was among that small group who helped clear the field of material and moral obstacles and made possible the building of the superstructure of the College. When the founders of this institution were told that the better class of Filipinos could not be attracted to an agricultural course, they pointed to Doctor Roxas and to a few others as shining examples of the kind of material that composed the student body of the new College.

Doctor Roxas paved the way for many significant events in the College. He was the first student to be appointed as an assistant and later as a pensionado of the College he was the first among its alumni to receive the doctorate degree from an American university. We shall long remember Doctor Roxas on the Campus for his many sterling qualities as a man and as a scientist, but of his many splendid services for the cause of the College and the student body, the Sugar Technology course and the Student Mess stand out as monuments to his initiative and enterprise and to his interest in the welfare of the youth of this country.

When the future shall have removed the material difficulties which beset an idealist with a family to raise from following his natural inclination, we shall hope to have Doctor Roxas once more with us with the added value of the prestige and experience which are bound to come to him from his present connections.

We wish him every kind of good luck.

B. M. GONZALEZ,
Acting Dean, College of Agriculture.

¹General Contribution from the College of Agriculture No. 206.

NOTE: THE CHARLES FULLER BAKER ENTOMOLOGICAL
COLLECTION

MUSEUM RECEIVES GREAT COLLECTION OF MALAY INSECTS

Enriched by nearly a third of a million specimens gathered together by Dean Baker, of University of the Philippines—collection largest of kind ever assembled

The United States National Museum has been enriched by the acquisition of what is undoubtedly the greatest collection of Malayan insects ever assembled, a collection brought together by Charles F. Baker, who was dean of the college of agriculture of the University of the Philippines in the period 1917-1927, and bequeathed by him to the Museum.

The collection contains specimens estimated by Dean Baker himself to number 250,000, but later estimated at more nearly 300,000 by R. A. Cushman, an associate entomologist of the Bureau of Entomology, who was assigned to task of going to the Philippines and packing it and bringing to the National Museum. It is contained in 1,417 standard Schmitt boxes 13 by 9 inches in size, distributed by orders as follows: Coleoptera 607, Hymenoptera 207, Homoptera 208, Hemiptera 115, Lepidoptera 125, Orthoptera 96, Diptera 40, and the remaining 19 divided among the smaller orders. The number of boxes devoted to family units varies from a fraction of 1 to 122, and there are many types and hundreds of species new to the national collection. Besides these specimens the collection includes a card catalogue, approximately 100,000 cards, all written by Dean Baker's hand, of all published references to Malayan Homoptera. To the uninitiated these figures mean little, but to one who has worked with insects and with cataloguing they mean an appalling amount of labor, says Mr. Cushman.

After having been appointed honorary assistant custodian of Hymenoptera by the National Museum, Mr. Cushman left Washington October 2 for the Philippines. It required considerable time to pack the collection, and in this work Mr. Cushman had the hearty cooperation of the college of agriculture, the Quartermaster Corps of the Army, and many private citizens. The boxes containing the collection were conveyed from Los Baños to Manila by barge and tug furnished by the quartermaster department, and on February 15 Mr. Cushman sailed with the collection on board the transport *Thomas*, bound for San Francisco. From San Francisco the collection was transshipped via the Panama Canal to New York, where it arrived April 7 on the transport *Cambrai*. Three days later it was transferred to a freight car, on which it arrived in Washington April 12, and on April 16 and 17 it was unpacked and distributed by orders to the various specialists in the Museum. The collection arrived in excellent condition, with a negligible amount of breakage. Some idea of its size may be gained from the fact that an aggregate of about 250 feet of shelf room was required for its temporary storage.

—*The Official Record* (U. S. Dept. Agric.)

COLLECTION OF BUGS RECEIVED

Carload of Maylayan Insects Left by Dr. Baker

Washington, May 6. (Exclusive)—A monument to the leisure hours of a great scientist in the shape of a carload of insect specimens has been received at the Smithsonian Institution. They came from the Philippines by United States Army transport via the Panama Canal. They represent the most extensive and varied collection of insects from the whole Malayan Archipelago extant. They were collected under the inspiration of the late Charles Fuller Baker, dean of the college of agriculture, University of the Philippines, and pinned and labeled entirely by his own hands when he was off duty.

The number of specimens is estimated at 300,000, while there are perhaps 50,000 more in the hands of the 115 specialists scattered over the world to whom Dean Baker had sent lots for identification before he died. He spent fifteen years of spare-time labor in making this collection.

Dr. L. O. Howard, former chief of the Bureau of Entomology, has said of Dean Baker: "I cannot believe that any other man will ever do as much in entomological lines."

Another authority describes Baker as "the greatest collector of insects that this generation has known and one of the best field botanists, having a wide acquaintance with both flowering plants and fungi."

The collection includes representatives of nearly all orders. Baker gathered them by personal collection, by sending out students and others to collect for him and by exchange. Areas from which specimens came stretch from Penang, Straits Settlements, to the Philippines, and there are representatives from Japan, China, Formosa, New Guinea and Australia. Nothing like this collection has ever been made and it is of immense scientific and economic importance. It includes an unknown quantity of type specimens already described and many new species yet to be described.

Because of the humidity of the Philippine climate, the danger from pests and from fire, it would have been unwise to leave the collection in the islands. Incorporated with the national collection under Smithsonian, it will be well taken care of and in addition will be available to a much greater number of specialists for study than it would be anywhere else. It was his recognition of these facts that led Dean Baker to will his collection to the Smithsonian. The task of incorporation will require years and much greater funds than are now available to the Smithsonian Institution.

Dean Baker stands out as one of the most remarkable naturalists in history. It is said of him that no other man who ever lived was responsible for the discovery of nearly as many new species as he. Aside from his energy which was phenomenal, he was the keenest of observers and found new species of plants and animals where others found nothing—a new species of moss in a chink of the wall of the botany laboratory at Stanford, a new poppy on the campus, a new flea on a squirrel in Nevada. As this indicates, also, his interests were as wide as natural history. As a teacher he seems to have had few equals. He wore himself out at the age of 55 but his achievements would do honor to three men.

The Baker collection was brought to this country by R. A. Cushman of the Bureau of Entomology and honorary assistant custodian of Hymenoptera in the National Museum. Mr. Cushman spent two and a half months preparing the 1400-odd boxes for shipment.

—*Los Angeles Times.*

A REVIEW: "PRACTICAL POULTRY-FARMING"¹

The value of poultry raising as a branch of Philippine agriculture is becoming more and more appreciated, judging by the increase in requests for information on this subject. In the past, most of these requests came from back-lot and from side-line poultry raisers. Recently, however, requests for information about large scale, or commercial poultry raising have been received. Publications on this line, therefore, will be gladly welcomed by those interested in the industry, especially those contemplating raising chickens, whether on a large or on a small scale.

Mr. Hurd², himself a successful poultry farmer and a poultry extension specialist, has written a "practical guide for both large and small poultry-keepers and those interested in starting a poultry enterprise." This book, not only for poultry raisers in the United States, but also in the Philippines, is a very valuable guide; the subject of poultry-farming could not be treated in a more thoroughly practical manner. The best and up-to-the-last minute practices of successful poultrymen, combined with the latest scientific discoveries in poultry feeding and management, written in a popular manner by a practical man, make the book a very useful manual for both large and small scale poultry raisers.

In its first twenty chapters, poultry-farming from A to Z is covered in a practical way. The first seventeen chapters are devoted to the care of poultry and the management of a poultry enterprise. The chapters on culling and selection are especially valuable because, as the author states, "many times success or failure of a poultry enterprise depends on this." The directness and clearness of the discussion of these phases of poultry-farming in this book make the chapters interesting and easy to apply in actual practice. Chapter XVIII gives popular pointers on the diagnosis and the prevention and control of poultry diseases and parasites. The last four chapters of the book are given to the discussion of the care and management of turkeys, guinea fowls and peafowls, ducks, geese and swans, pigeons, and pheasants.

Because local conditions in the Philippines differ widely from those in the temperate countries for which the book was particularly written, some of the recommendations given must be modified or adapted. Local methods of poultry management must necessarily be based on actual conditions existing in the locality, and for this reason a Filipino poultry man should be careful in the application of some of the different practices and methods given in this book. But in spite of the difference in the conditions in the Islands and those in the United States, Mr. Hurd's book will be of useful service to local poultry raisers as application of the scientific principles is the same in both countries. The many illustrations in the book add to its value as a reference book for students of poultry-farming, as well as for those contemplating engaging in poultry raising in this country.

F. M. FRONDA,

Of the Department of Animal Husbandry

¹General Contribution from the College of Agriculture No. 207.

²Hurd, Louis M. 1928. Practical poultry-farming. xxiii+405 p. 149 fig. New York: The Macmillan Company.

EXTENSION DIVISION NOTES

Prepared by Moises M. Kalaw under the supervision of Prof. Inocencio Elayda

A Graduate's Experience in Clearing Forest Land

Pacifico L. Masibay of the class of 1925 writes from Zaragoza, Nueva Ecija, recounting his farm experience after his graduation. He tells us that in 1927 he bought a twenty-hectare piece of agricultural land. Of that area 12 hectares were a second-growth forest, two hectares in mango orchard and six hectares rice land.

The mango orchard and the rice land gave him little concern as their operation is routine work, although he hopes to introduce later some improvement in the yield of the crops and the management of the farm business. His first concern was to bring the wooded portion under cultivation by the initial process of clearing the forest.

In doing this he employed two methods of clearing. The first operation in clearing the first eight hectares consisted of underbrushing and felling the large trees leaving about half a meter of stump. Subsequently these stumps were grubbed out. Both the logs and the big stumps were piled in a corner, while all the light stuff such as small branches were left on the land and burned when dry. The area thus cleared was planted by *caiñgin* method to rice. Mr. Masibay found that in the operation they grubbed out 16,756 stumps varying from 5 centimeters to 80 centimeters in diameter and twice as many smaller stumps. Employing 24 men, the work finished in about a month at a cost of ₱1,003.

For the remaining four hectares of the forest area he used another method of clearing. After cutting the underbrush the trees were grubbed down to the roots on the side of the trunk opposite the tree inclination. By utilizing the dead weight of the crown, branches, and trunk the trees were felled and uprooted at one operation. This method was much cheaper than the first as it dispensed with the chopping down of the trees and the grubbing out of the stumps. The lopping of the branches, drying, burning, and clearing of the trash and planting the first crop were performed as under the first method. It took a month to finish this work with only five men and at a cost of ₱470.

Comparing the two methods used in clearing his land, Mr. Masibay concluded that the second method required "less labor, less physical exertion, less time and less capital per unit of area". It is to be presumed that he was induced to use the first method because it is the one commonly practiced in the Islands in clearing a forest land for *caiñgin* purposes. In this connection, however, it must be borne in mind that for *caiñgin* the stumps

of large trees and the logs are left in place to decay. Generally the effect of a good burning is so complete that most of them are killed and the few that survive are kept shorn of new shoots until they perish and decay. With this practice the first method may prove as economical as the second, except that in the first it is three or more years before the land can be plowed, while as Mr. Masibay cleared it the land can be plowed at once. But there is seldom the necessity for breaking newly cleared land with the plow. The burning process, besides sweetening the soil for plant culture through the destruction of the excess of accumulated organic matter, is known to have practically the same effect in providing the soil with proper aëration as breaking the land with the plow. The cracks formed in the soil as a result of the burning serve as air passages substantially the same as though the ground had been stirred up with farm implements.

However, for his own benefit, what counts in the experiment made by Mr. Masibay is the experience he gained by personally conducting the work and seeing the result of his own plan. He is now in a position to tell that actual experience is the best means of learning a craft, as it gives confidence in one's ability to do work.

Tephrosia Solving a Problem in Coconut Planting

Up to the time of bearing, the most difficult problem coconut growers meet comes three or four years after planting. At this stage the plants have grown to a height which makes the raising of crops between the coconut plants no longer profitable. If a planter is handling two or three hectares it will be possible to clean them even without getting any returns. But when a farmer is handling a plantation of say a hundred hectares he cannot afford to maintain so large an area under cultivation for so long a period without any returns. But it is very necessary that the plantation be kept clean or free from harmful weeds like the cogon. Once a plantation is neglected at this stage and the cogon takes possession the growth of the nuts is retarded by about three years. All coconut growers know this. They know that many coconut plantations have been damaged if not actually destroyed by cogon. How to prevent cogon growing in his plantation has troubled many a coconut grower.

I know of several cases in which the inability to combat this plant caused a great expense to or ruined the planter. An efficient farm manager in a nearby province has failed as a coconut planter and lost a large sum of money just because he was not able to overcome this difficulty. Several years ago he entered into a contract with a rich land owner. The contract was that he would plant for the owner a three-hundred-hectare farm with coconuts. He was to be responsible for all expenses and have all the crops that he could raise from the land while planting the coconuts. The land owner was to loan him the necessary capital. After seven years the land

owner would pay him one peso a coconut tree that he had planted provided that the plantation was in a satisfactory condition.

The manager made good in the first part of the contract. He was able to cover all the 300 hectares with coconuts. But three years after planting the coconuts he met a problem which he was not able to solve and which caused his failure. After three years he could not raise any more crops for the subsistence of his men. He could not afford to have the land plowed or cultivated without getting any returns. But he was required to keep the plantation clean, otherwise the owner would not pay him. He tried his best to fulfill the contract, but the undertaking was too great for him. At last he tried to make the plantation a pasture for farm animals. But the animals proved harmful to the coconuts and this gave good ground for complaint by the landowner. Later, the farmer had to give up and leave the farm to nature. The land virtually became a cogonal between the coconuts. At the end of seven years he submitted the plantation to the landowner, who, naturally was not satisfied with the condition of the plantation and would not pay him the one peso a tree. The manager took the matter to court, but the case was decided in favor of the landowner, except that the manager's debt would be cancelled. But his loss was about 10,000 pesos.

I had a talk with this farm manager recently and he told me that his failure was mainly because he was not able to find a plant, a cover crop, suited for growing in the plantation after the third year. He said that had he known of *Teprosia* at that time he could have prevented his failure as he could have submitted the plantation in a most satisfactory condition. But he knew of no suitable cover crop. He could not use the legumes that are common in the locality as they are annual crops and, besides, the people will gather them for their own use. He said that *Teprosia* is the only plant that could have saved him.

Another farm manager who entered into a contract similar to this one is now facing a similar problem. But this farm manager is trying to make good his contract at any expense. So for the last three years he has been spending large sums keeping the plantation clean, though he knew he was losing. Recently he learned of the use of *Teprosia* in Batangas and recognized that it is the crop that he badly needs and began to plant it. He has so far planted about 28,000 coconut trees and he hopes to cover the area between them with *Teprosia*. He is quite sure of success from results that he saw in Batangas. Were it not for *Teprosia* he would meet the same fate as the manager cited above.

In previous years many cases similar to these two have been known. It is common in a developing coconut district to see the plantation covered with cogon or other obnoxious weeds. In some places cacauate or madre cacao, a kind of leguminous tree, is being used as a cover crop. In some cases it succeeds. But this plant is quite difficult to handle. From results

actually seen there is no doubt of the effectiveness of *Teprosia* as a cover crop for coconuts.

The method of planting *Teprosia* is simple. Prepare the soil as for corn. Make furrows about 80 centimeters apart. Plant the seeds in the same way as mungo. If the cogon or any grass that is to be killed is thick make the planting a little closer. Within six months the *Teprosia* will have grown so tall that no other plants can grow under it. If desired it can be cut to any desirable height.

Developing a Piece of Public Land

In our last Extension Division Notes a brief discussion of land prospecting and selection of site for a farm was given. In personal trips made recently through a public land region in the province of Camarines Sur prospecting for land we experienced the same difficulties as given in our Extension Notes. On two different trips we spent days and days in the interior of the forest, opening our way through it by swamping and blazing our way with the help of a compass. There was quite a number of people in the party. Laborers were employed to carry baggage and provisions and help clear the way. The party camped in the forest when night came. At times the party had to go on a much reduced ration, and at times without any—depending upon the supply secured from the nearest settled community. And for these supplies exorbitant prices were paid. To prospect for land in unopened regions requires pluck and endurance against fatigue and resistance against sickness that may be contracted from exposure, lack of shelter and over-exertion.

But when the question of public land settlement comes up for discussion in the press, in a convention, or official correspondence, the question is usually dismissed by asking: Why do our young men not have the courage to rush to homesteading and occupying our rich agricultural public land which is waiting for energetic hands to convert it into gardens? They do not stop to think of the help that should be extended in this kind of pioneering work before it can be translated into reality, and before people in greater numbers can be induced to venture in such an undertaking. In every case settlers need money to start with not only in developing the land so acquired but also in financing the preliminary work in locating and selecting the site.

In our prospecting work we drifted into places where settlers were already occupying and developing a piece of public land either through homesteading or special permits for *caiñgin* camp, or residence. Some of these settlers are residents or natives of the nearest communities and others hail from distant provinces. They all recognize the fact that they had to have the money to start with and a working capital to develop the land until their plantings began to produce harvest to help provide for their daily needs and enable them to save and supplement their initial capital.

The most wide-awake settlers have followed the following procedure in getting possession of a piece of public land.

1. They select the site first and delimit by cutting the boundary lines and keeping them clean on four well marked corners.

2. Filing the application for a homestead entry with the Bureau of Lands when the land in question is declared to be suited for agriculture; or for *cañgin* or residence or camp permit with the Bureau of Forestry if the land is held under the jurisdiction of this Bureau.

3. In the case of homesteads once the application is approved the applicant enters the land and begins to develop it. He is given five years' time to get the land developed, at the expiration of which when all the legal requisites are complied with, he is issued a Torrens title.

4. In the case of special permits from the Bureau of Forestry he can hold the land only for a certain period of time on condition that he is to use the land only for annual not permanent crops. If the land covered by these special permits is declared agricultural land open for occupancy by proclamation of the Governor General, it can be applied for as homesteads or as purchase from the government, the area for each being amplified to the extent allowed by law—24 hectares for a homestead and 144 hectares for purchase by an individual.

These homesteaders developed their land by the practice of *cañgin* method of farming. The land is cleared piece by piece, the size of clearing depending upon the resources and co-operative work at the disposal of the settler. Rice and corn are generally planted the first year together with bananas, sweet potatoes, and native garden vegetables for the use of the family. Where coconuts are to be planted if the seedlings have been previously prepared for transplanting, they are set out before the rice is planted. These interplantings continue until the land, with the rotting out of big logs and stumps, is in shape for plowing. In many cases to minimize the expense in weeding, the land is plowed between the rows of coconuts and planted to intercrops until the coconut trees have grown large enough to shade all the area supporting the so-called permanent plantation.

This brief account is not by any means complete, but the value of it lies in that the data have been gathered from actual field pioneering work by coming in touch with the pioneers themselves. And one thing that stands out is that the man who ventures into this kind of an enterprise has to have some initial capital to meet the necessary expenses of locating the site, filing the application for the land, delimiting the land and keeping the boundary lines clean and distinct, watching it and keeping out trespassers, entering the land, clearing and planting and keeping up the plantation, and meeting all the living expenses on a new settlement. This expenditure goes on for the first year unsupplemented with the produce of the intercrops as these come generally the second year of cropping.

EXCHANGE NOTES

George Washington seemed to be passionately fond of trees, shrubs and hedges and records: "I shall begrudge no reasonable expense that will contribute to the improvement and neatness of my farms, for nothing pleases me better than to see them in good order and everything trim, handsome and thriving about them; nothing hurts me more than to find them otherwise."

—*California Cultivator*.

Vegetable leaves and stumps should never be thrown on the ground in the poultry run; some of them may be left to decay, and possibly be the cause of ptomaine poisoning, or of an outbreak of infectious disease. Green stuff, if not chaffed, can be placed in wire-netting baskets and hung up in the pen, and the birds will pull it through the mesh.

—*Journal of Agriculture* (Victoria).

Argentina, one of our chief competitors in the world's agricultural markets, is rapidly growing in importance. In 1927 its agricultural exports were half again as much in value as in 1923. During the last five years 96 per cent of the country's exports were of agricultural products, yet only a small part of the potential tillable land has been brought into cultivation, only eight per cent of the country's total area being in cultivation.

A large portion of the cultivated area is in the hands of comparatively few holders. Most of the holdings average 1,200 acres or more in size. In 1920 about 59 per cent of Argentina's farmers operated only 3½ per cent of its farm lands, while in the United States 59 per cent of our farmers operated 17 per cent of the farm land.

—*The Prairie Farmer* (Illinois).

Roselle is a native of the old world and India. How was it introduced in Europe in 1576 is not understood; however, it is known for certain that it found its way into the Botanic Gardens of England in 1596 from Jamaica. The culinary uses of the plant's calyces were recognized early in the 18th century in the West Indies. The uses of the leaves of the plant were long known to Javanese, as early as 1658. In India it is being grown along with *H. cannabims* chiefly for its fibre, sold as Bimbipatan jute, and the leaves and young tender shoots as vegetable. Roselle has long been cultivated in

Mexico, in parts of Central America and West Indies. It has been reported as an horticultural crop in Australia and in 1898 two factories were reported as working and exporting jam to Europe.

—*Poona Agricultural College Magazine* (India).

A news item is at hand which tells of the work of Dr. William H. Diefenbach of the Flower Hospital, New York, in producing female chicks only from hatching eggs that were treated with X-rays. There seems to be no explanation for this result, although one explanation suggested by scientists is that the powerful rays succeeded eventually in destroying the male producing chromosome within the fertilized egg. This sounds like additional proof that the female is hardier than the male.

He has been experimenting along this line for the last 3 years and has produced chicks with marked peculiarities. Exposures to the X-rays up to several hours have produced chicks with deformities, such as the absence of wings.

—*American Poultry Journal*.

One Mid-West farmer found his fields infested with white grubs and cutworms. He put up well-built bird houses, and now says that the white grubs are gone and he has not seen a cutworm for five years.

Another farmer had trouble with tree scale and fruit worms until he attracted summer birds to his orchard. In a few years the pests were gone and his trees produced fine fruit. By building bird-houses, people all over the country have benefited their fields. Even though a little grain or fruit is eaten by the birds, it is small pay for all the good done.

—*The Prairie Farmer* (Illinois).

Reports have it that the first sack of sugar manufactured at Black Hills, South Dakota, was sold for \$1,000 to the Sioux City Stock Yards Company. The "Centralblatt" of Germany calls this "echt Amerikanisch," real American, but adds that it is not a bad scheme and evidently wishes some of their factories could have such an exciting time. Withal, the coming of a sugar factory is worth while magnifying in any state and community because of its lasting benefits to the commonwealth.

—*The Planter and Sugar Manufacturer*.

COLLEGE AND ALUMNI NOTES

Mr. Reginald King, A. B. and M. S., University of California, has been appointed Professor of Sugar Technology. Professor King reported for duty on July 20, 1928.

Mr. Leandro S. Ebro, B. S. '26 and M. S. in M. E. '27, University of California, has been appointed Instructor in Sugar Engineering, effective

June 16, 1928. Before coming to the College, Mr. Ebro was employed in the Philippine Bureau of Public Works.

Dr. Miguel Manresa, U. P. Fellow at University of Wisconsin, writes Dean Gonzalez that he has "satisfactorily completed the final requirements for the doctorate". He will spend some time in eastern United States visiting Washington and important universities. He will return to the Philippines via Suez Canal, spending forty-five days in Europe. He will arrive in the Philippines about the opening of the second semester.

The Los Baños Colleges' Tennis Club was successfully opened July 4, 1928. Tennis enthusiasts from different tennis clubs in Laguna were present. The success of the affair was due to the untiring efforts of the club president, Dr. F. T. Adriano.

Mr. Getulio A. Guanzon, Assistant in Sugar Technology, who has been on accrued leave, reported for duty July 2, 1928.

The Makiling Echo for July presents two valuable papers, "Classification of Public Lands in P. I." and "Railroad Ties for Sugar Centrals" and interesting notes on the forestry work.

The Secretary reports enrollment for the first semester to be 792. There are 23 co-eds this year and 9 foreign students.